Supplementary material

The adiabatic passage pulse sequences used in these experiments are shown below in the figure. They follow a similar for to those used in reference 2 and 4. (a) corresponds to the pulse sequence applied to the microwire source during normal MRFM measurements including those shown in Fig. 3 of the paper. T_c is the period of the cantilever and corresponds in the text to $T_c = 2\pi/\omega_m = 385$ μs in the text. ν_{RF} is the carrier frequency of the pulses and is swept in Fig. 3, for example. $\Delta\nu = \Omega_{RF}/(2\pi)$ is the modulation width, which in these experiments is 600 kHz. a and b are amplitude modulation parameters which in these experiments were set to $a = 0.2$ and $b = 0.5$. B_1 is the magnitude of the rotating magnetic field produced at the sample by the microwire. In the case of our experiments $B_1 = 12$ mT as demonstrated in the nutation experiment of Fig. 5. (b) corresponds to the pulse sequence used for the nutation experiment plotted in Fig. 5. Here $T_p = 500 \times T_c = 190$ ms is the repetition rate of the variable length pulse. The length of the pulse is given by τ_p and is swept in Fig. 5, for example.

Figure 1

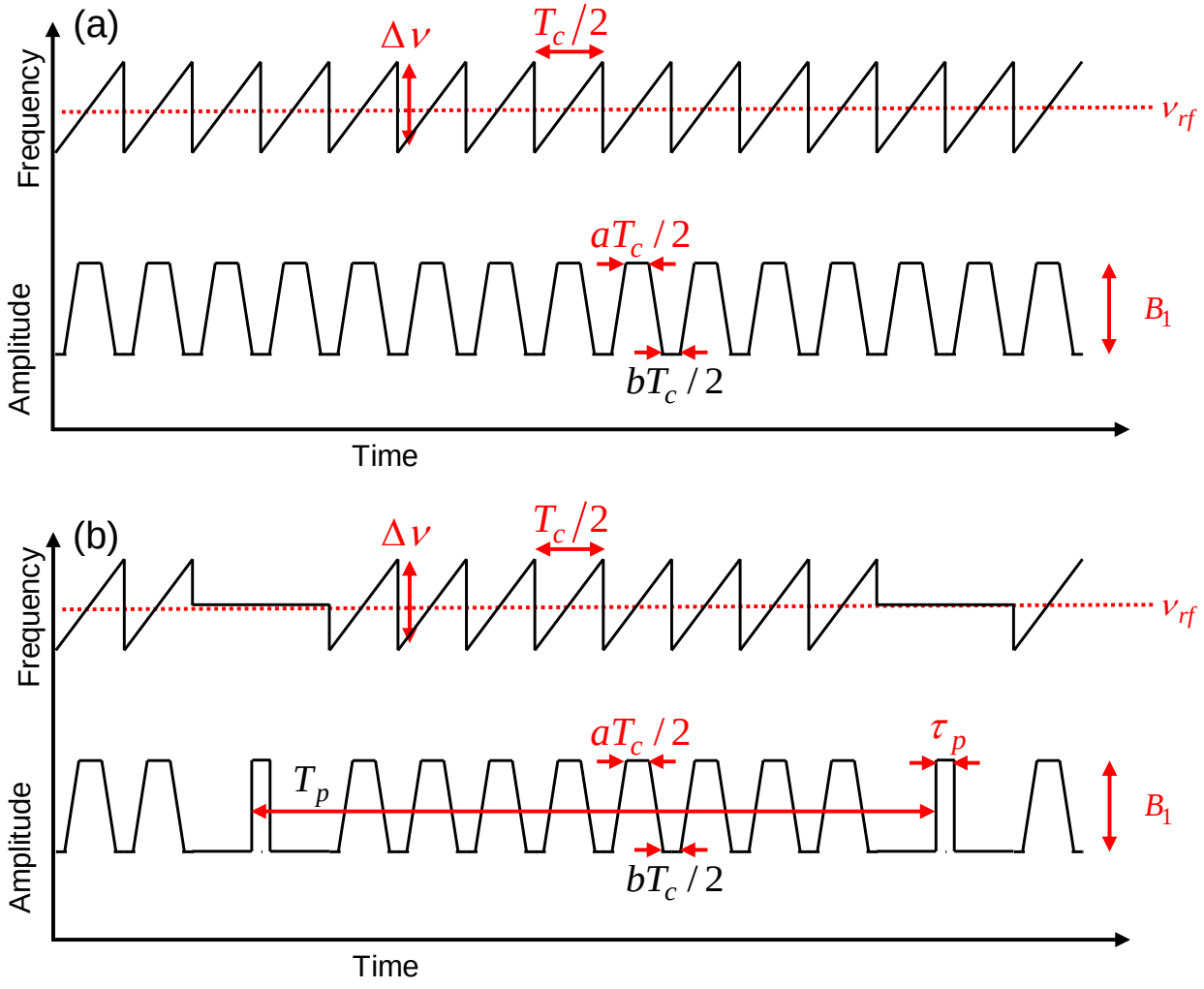

Table I

FeCo tip parameters	
Geometry	Truncated cone magnetized along the z-direction
Apex diameter	270 nm
Base diameter	510 nm
Height	250 nm
Saturation magnetization	10^6 A/m
Polystyrene sample parameters	
Geometry	Sphere
Radius	625 nm
^{1}H density	4.9 x 10^{22} cm^{-3}

Figure 2
Scanning Electron Microscope image of cantilever with polystyrene attached similar to the one measured in the experiments presented: